

What is claimed is:

1. A communication device for transmitting and/or receiving signals using a communication antenna, comprising:

5 signal characteristic information detection means for detecting information regarding signal characteristics of a calibration signal contained in a signal received by the communication antenna;

calibration means for calibrating a communication antenna chain based on the detected signal characteristic information;

10 cancellation signal generating means for generating a cancellation signal corresponding to a calibration signal contained in the signal received by the communication antenna based on the calibration signal;

signal cancellation-by-subtraction means for subtracting the generated cancellation signal from the signal received by the communication antenna; and

15 receive signal processing means for processing the received signal diminished by the cancellation signal.

2. A communication device according to claim 1, further comprising a calibration signal transmitting antenna for transmitting a calibration signal to the communication antenna.

3. A communication device according to claim 1, further comprising:

20 calibration signal transmitting means for transmitting a calibration signal from a communication antenna; and

a calibration signal receiving antenna for receiving the calibration signal transmitted from the communication antenna;

25 the signal characteristic information detection means detecting information regarding the signal characteristics of the calibration signal received by the calibration signal receiving antenna, and the calibration means calibrating the communication antenna chain based on the detected signal characteristic information.

4. A communication device according to claim 2, further comprising:

30 calibration signal transmitting means for transmitting a calibration signal from a communication antenna; and

a calibration signal receiving antenna for receiving the calibration signal transmitted from the communication antenna;

the signal characteristic information detection means detecting information regarding the signal characteristics of the calibration signal received by the calibration signal receiving antenna, and the calibration means calibrating the communication antenna chain based on the detected signal characteristic information.

5 5. A communication device according to claim 1, further comprising:  
a signal generator for generating a signal of prescribed frequency for  
converting signal frequency, a frequency signal generated by a common signal generator  
10 being supplied to multiple antenna chains including all communication antenna chains.

6. A communication device according to claim 2, further comprising:  
a signal generator for generating a signal of prescribed frequency for  
converting signal frequency, a frequency signal generated by a common signal generator  
being supplied to multiple antenna chains including all communication antenna chains.

15 7. A communication device according to claim 3, further comprising:  
a signal generator for generating a signal of prescribed frequency for  
converting signal frequency, a frequency signal generated by a common signal generator  
being supplied to multiple antenna chains including all communication antenna chains.

8. A communication device according to claim 4, further comprising:  
20 a signal generator for generating a signal of prescribed frequency for  
converting signal frequency, a frequency signal generated by a common signal generator  
being supplied to multiple antenna chains including all communication antenna chains.

9. A communication device according to claim 1, wherein transmission/reception  
of a calibration signal by the communication antenna and detection of information  
25 regarding signal characteristics of the calibration signal by the signal characteristic  
information detection means are performed at intervals.

10. A communication device according to claim 2, wherein  
transmission/reception of a calibration signal by the communication antenna and  
detection of information regarding signal characteristics of the calibration signal by the  
30 signal characteristic information detection means are performed at intervals.

11. A communication device according claim 3, wherein transmission/reception of a calibration signal by the communication antenna and detection of information regarding signal characteristics of the calibration signal by the signal characteristic information detection means are performed at intervals.

5 12. A communication device according claim 4, wherein transmission/reception of a calibration signal by the communication antenna and detection of information regarding signal characteristics of the calibration signal by the signal characteristic information detection means are performed at intervals.

10 13. A communication device according claim 5, wherein transmission/reception of a calibration signal by the communication antenna and detection of information regarding signal characteristics of the calibration signal by the signal characteristic information detection means are performed at intervals.

15 14. A communication device according claim 6, wherein transmission/reception of a calibration signal by the communication antenna and detection of information regarding signal characteristics of the calibration signal by the signal characteristic information detection means are performed at intervals.

20 15. A communication device according claim 7, wherein transmission/reception of a calibration signal by the communication antenna and detection of information regarding signal characteristics of the calibration signal by the signal characteristic information detection means are performed at intervals.

16. A communication device according claim 8, wherein transmission/reception of a calibration signal by the communication antenna and detection of information regarding signal characteristics of the calibration signal by the signal characteristic information detection means are performed at intervals.

25 17. A CDMA base station comprising:

■ number of communication antennas constituting an adaptive array antenna, ■ being greater than 1, ■ number of transceiver units and ■ number of calibration signal cancelers, which members constitute ■ number of communication antenna chains, and a user-segregated AAA signal processor and discriminator common to the ■ number of communication antenna chains;

wherein:

each calibration signal canceler includes a despreader, a phase/gain error detector, a calibration signal generator, a complex multiplier and a subtracter;

5 each communication antenna transmits and receives spread spectrum signals to and from mobile stations by radio;

10 each receiver unit conducts receive processing consisting of frequency-converting and orthogonally detecting received signals acquired from the associated communication antenna and outputting the result of the orthogonal detection to the associated calibration signal canceler, and conducting transmit processing consisting of orthogonally modulating and frequency-converting a transmit signal received from the associated calibration signal canceler and outputting the result to the associated communication antenna;

15 the despreader of each calibration signal canceler acquires the received signal from the associated communication antenna, despreads it using a spreading code corresponding to the calibration signal, thereby detecting the calibration signal contained in the received signal, and outputs the detection result to the associated phase/gain error detector, the phase/gain error detector detects the phase variation and gain variation of the calibration signal based on the detection result received from the despreader, deletes the phase component of the calibration signal produced on the 20 calibration signal transmission side from the received calibration signal and outputs the result after deletion to the associated complex multiplier, the associated calibration signal generator generates a signal identical to the calibration signal transmitted from the calibration signal transmission side and outputs the generated signal to the complex multiplier, the complex multiplier complex-multiplies the result after deletion received 25 from the phase/gain error detector and the generated signal received from the calibration signal generator and outputs the multiplication result to the associated subtracter as a cancellation signal, the subtracter subtracts the cancellation signal received from the complex multiplier from the received signal of the associated communication antenna chain input thereto by the associated transceiver unit and outputs the received signal 30 after subtraction to the user-segregated AAA signal processor and discriminator;

the user-segregated AAA signal processor and discriminator conducts receive processing consisting of acquiring the received signals of the communication antenna chains from the calibration signal cancelers, multiplying these signals and receive weights applied to the communication antenna chains and synthesizing the 5 multiplication results for all communication antenna chains to produce a synthesis result that is a received signal of the adaptive array antenna, this processing being done for every mobile station, conducts transmit processing consisting of modulating user-specific data for  $X'$  number of users, summing the modulated signals to produce transmit signals and multiplying the transmit signals and transmit weights applied to the 10 communication antenna chains, and outputs the multiplication results for the respective communication antenna chains to the transceiver units via the calibration signal cancelers.

18. The CDMA base station according to claim 17, further comprising:

15 a calibration signal transmitting/receiving antenna;  
a calibration signal transceiver unit; and  
a calibration signal processor;  
wherein:  
the calibration signal processor include a calibration signal generator, a spreading code generator, a desreader, a phase/gain error detector and a controller;

20 the calibration signal transmitting/receiving antenna radio-transmits a calibration signal input thereto from the calibration signal transceiver unit and outputs signals received by radio transmission to the calibration signal transceiver unit;

25 the calibration signal transceiver unit receives the calibration signal from the calibration signal processor, orthogonally modulates and frequency-converts it and outputs it to the calibration signal transmitting/receiving antenna, and acquires received signals from the calibration signal transmitting/receiving antenna, frequency-converts and orthogonally detects them and outputs the result of the orthogonal detection to the calibrating signal processor;

30 in a transmission system of the calibration signal processor, when performing receive calibration of a communication antenna chain, the calibrating signal generator

operates under the control of the controller to generate a fixed spreading code as a calibration signal and output the calibration signal to the calibration signal transceiver unit; and

5       in a reception system of the calibration signal processor during transmit calibration of a communication antenna chain upon reception of a calibration signal among calibration signals transmitted in turn from the communication antenna chains, the controller instructs the spreading code generator to generate a spreading code corresponding to the received calibration signal and the spreading code generator operates under the control of the controller to generate the instructed spreading code and  
10      output it to the despreader, the despreader correlates the received signal acquired from the calibration signal transceiver unit and the spreading code supplied by the spreading code generator, and the phase/gain error detector detects the phase variation and gain variation of the calibration signal based on the despreading result received from the despreader .

15      19. The CDMA base station according to claim18,wherein:

      the receiver unit of each communication antenna chain includes a low noise amplifier, a mixer, a band pass filter, an auto gain controller, an orthogonal detector, and low pass filters;

20      the transmitter unit of each communication antenna chain includes low pass filters, an orthogonal modulator, a band pass filter, a mixer, a band pass filter, and a power amplifier;

      the calibration chain transmitter unit comprises low pass filters, an orthogonal modulator, a band pass filter, a mixer and a band pass filter,

25      the calibration chain receiver unit comprises a mixer, a band pass filter, an orthogonal detector, and low pass filters;

      the receive side mixers of the communication antenna chains and the transmit side mixer of the calibration chain are supplied with a receive side first local frequency signal generated by a common first signal generator, and the receive side orthogonal detectors of the communication antenna chains and the transmit side orthogonal modulator of the calibration chain are supplied with a receive side second local

frequency signal generated by a common second signal generator; and

the transmit side orthogonal modulators of the communication antenna chains and the receive side orthogonal detector of the calibration chain are supplied with a transmit side first local frequency signal generated by a common third signal generator,

5 and the transmit mixers of the communication antenna chains and the receive side mixer of the calibration chain are supplied with a transmit side second local frequency signal generated by a common fourth signal generator.

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